Indian Space Research Organisation

Mars Orbiter Mission

Indian MOM (Mars Orbiter Mission)

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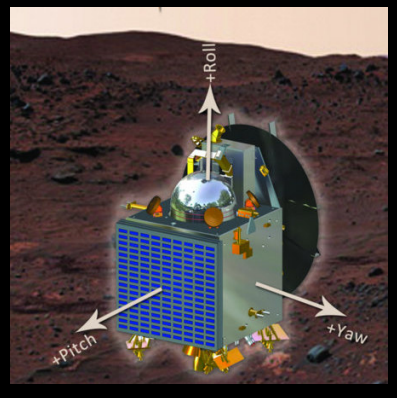


MARS
ORBITER
MISSION
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Objectives : Indian Mars Mission

To develop the technologies required for design, planning, management, and operations of an interplanetary mission.

A) Technological Objectives:

- ✓ Design and realisation of a Mars orbiter with a capability to survive and perform Earth bound manoeuvres, cruise phase of 300 days, Mars orbit insertion / capture, and on-orbit phase around Mars.
- ✓ Deep space communication, navigation, and management.
- ✓ Incorporate autonomous features to handle contingency situations.

B) Scientific Objectives:

Exploration of Mars surface features, morphology, mineralogy and Martian atmosphere by indigenous scientific instruments.

MOM Spacecraft

Lift-off Mass	1337 kg
Propulsion	Bi propellant system (MMH + N_2O_4) Propellant mass : 852 kg
Thermal System	Passive thermal control system
Power System	Single Solar Array - 1.8m X 1.4 m - 3 panels 840 W Generation (in Martian orbit)
Antennae	Low Gain Antenna (LGA), Mid Gain Antenna (MGA), and High Gain Antenna (HGA)
Launch Date Time & Site	5 Nov. 2013 at 14.28 Indian Time Sriharikota, India
Launch Vehicle	PSLV - C25

Indian Mars Orbiter Mission Spacecraft after integration with the fourth stage of Polar Satellite Launch Vehicle (PSLV-C25)

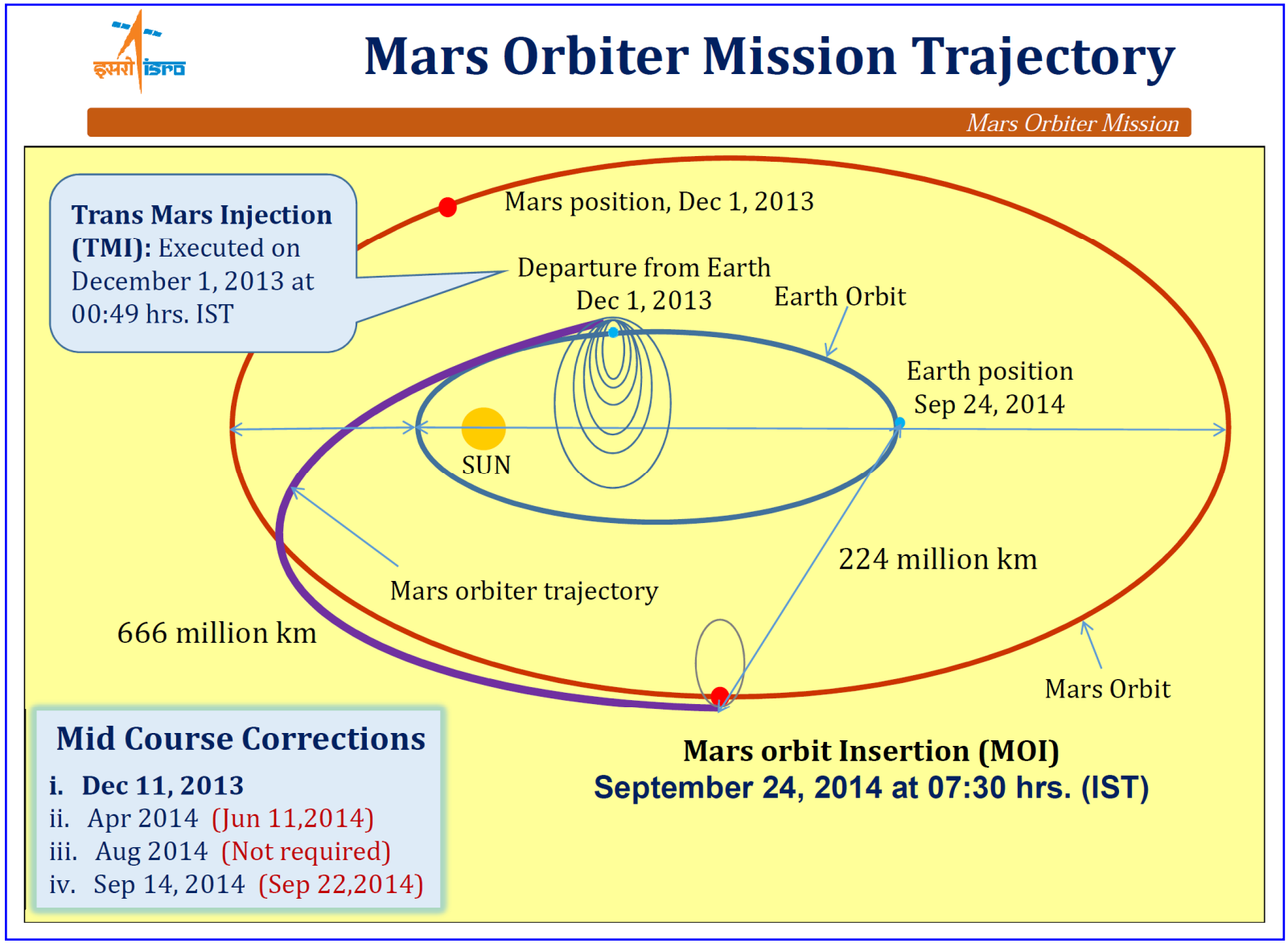
@MST in Shriharikota (SHAR)

MOM integrated on the PSLV-C25 launch vehicle

'T zero‘ – 14:38 Indian Time
05 Nov. 2013

The mission consists of following three phases:

(1) Geo-Centric Phase (2) Helio-Centric Phase (3) Martian Phase



Major events before MOI

Sl. No.	Activity	Date
1	Uploading of commands	14-09-14 15-09-14
2	Verification of uploaded commands	14-09-14 15-09-14
3	Entry into Sphere of Influence of Mars	22-09-14
4	Fourth Trajectory correction manoeuver and test-firing of Main Liquid Engine • Duration : 3.968 seconds • Fuel consumption: 0.567 kg • ΔV : 2.142 m/s	22-09-14 @1430 Hrs (IST)
5	Health Monitoring & checks	Ongoing


Liquid Engine
Test Firing
Sep 22, 2014
The 4th Trajectory Correction Manoeuver is also configured to verify the operation of the Main Liquid Engine which has been idle for about 10 months.

The D Day - 24th September,2014

Mars Orbiter Mission

	When?	IST	What?
1	T-3 hours	04:17:32	Change over to Medium Gain Antenna
2	T-21 minutes	06:56:32	Forward rotation starts
3	T-5 minutes 13 seconds	07:12:19	Eclipse starts
4	T-3 minutes	07:14:32	Attitude control with thrusters
5	T	07:17:32	Liquid Engine Burn starts
6	T+4.3 minutes	07:21:50	Mars occult starts
7	T+5 minutes	07:22:32	Telemetry OFF
8	T+ 12.5 minutes	07:30:02	Confirmation of Burn start
9	T+19.48 minutes	07:37:01	Eclipse ends

All time in Indian Standard Time (IST); IST = GMT + 5:30 hrs = PDT + 12:30 hrs

The D Day-24th September, 2014

Mars Orbiter Mission

	When?	IST	What?
10	T+ 24.23 minutes	07:41:46	Liquid engine Burn Ends
11	T+ 25.73 to T+ 47 minutes	07:42:46 to 08:04:32	Reverse Manoeuver starts
12	T+ 27.78 minutes	07:45:10	Occult ends
13	T+ 30.43 minutes	07:47:46	Telemetry resumes and Doppler measurement to provide first information about total burn performance
14	T+ 35.23 minutes	07:52:46	Reverse Manoeuver ends

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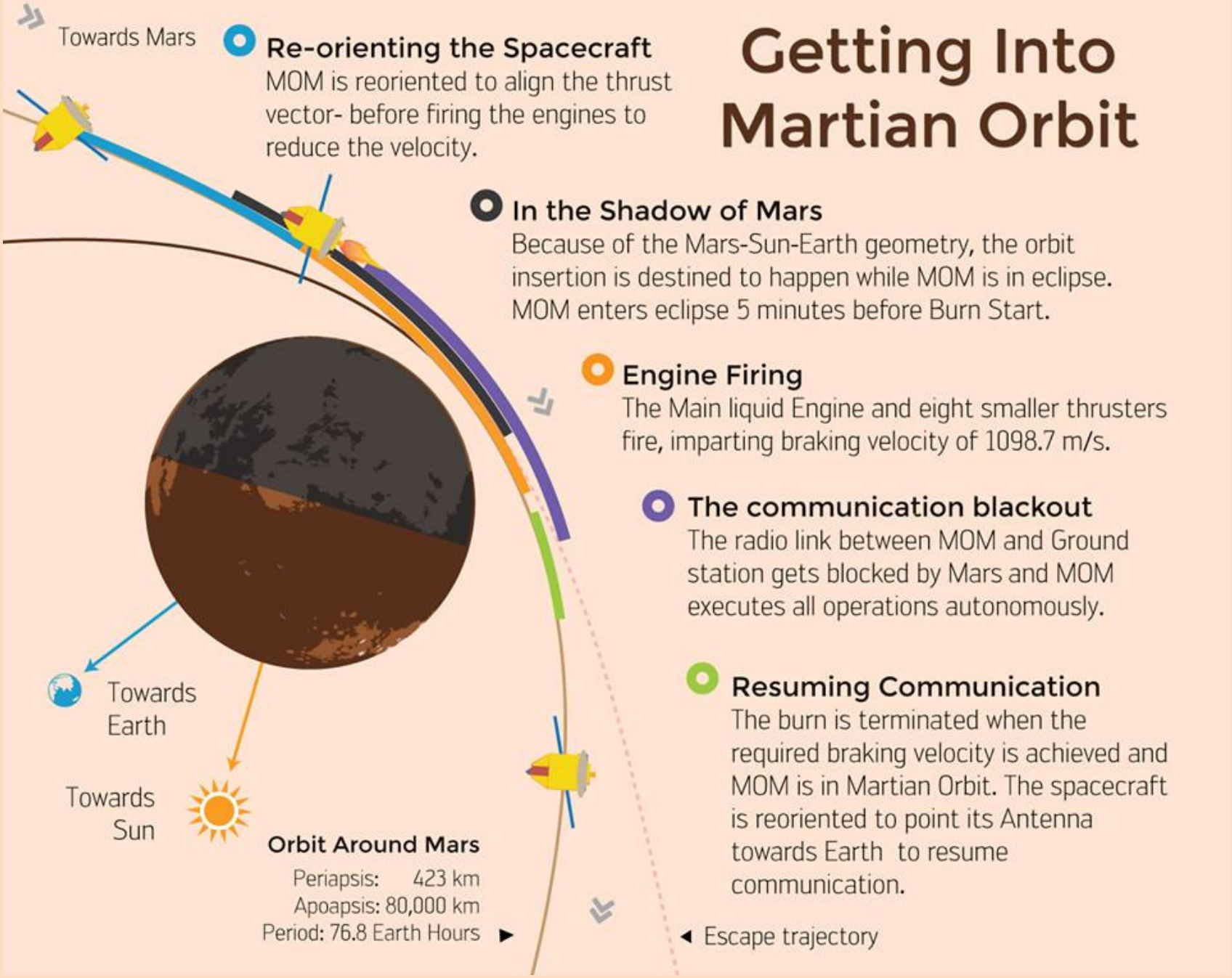
Getting Into Martian Orbit



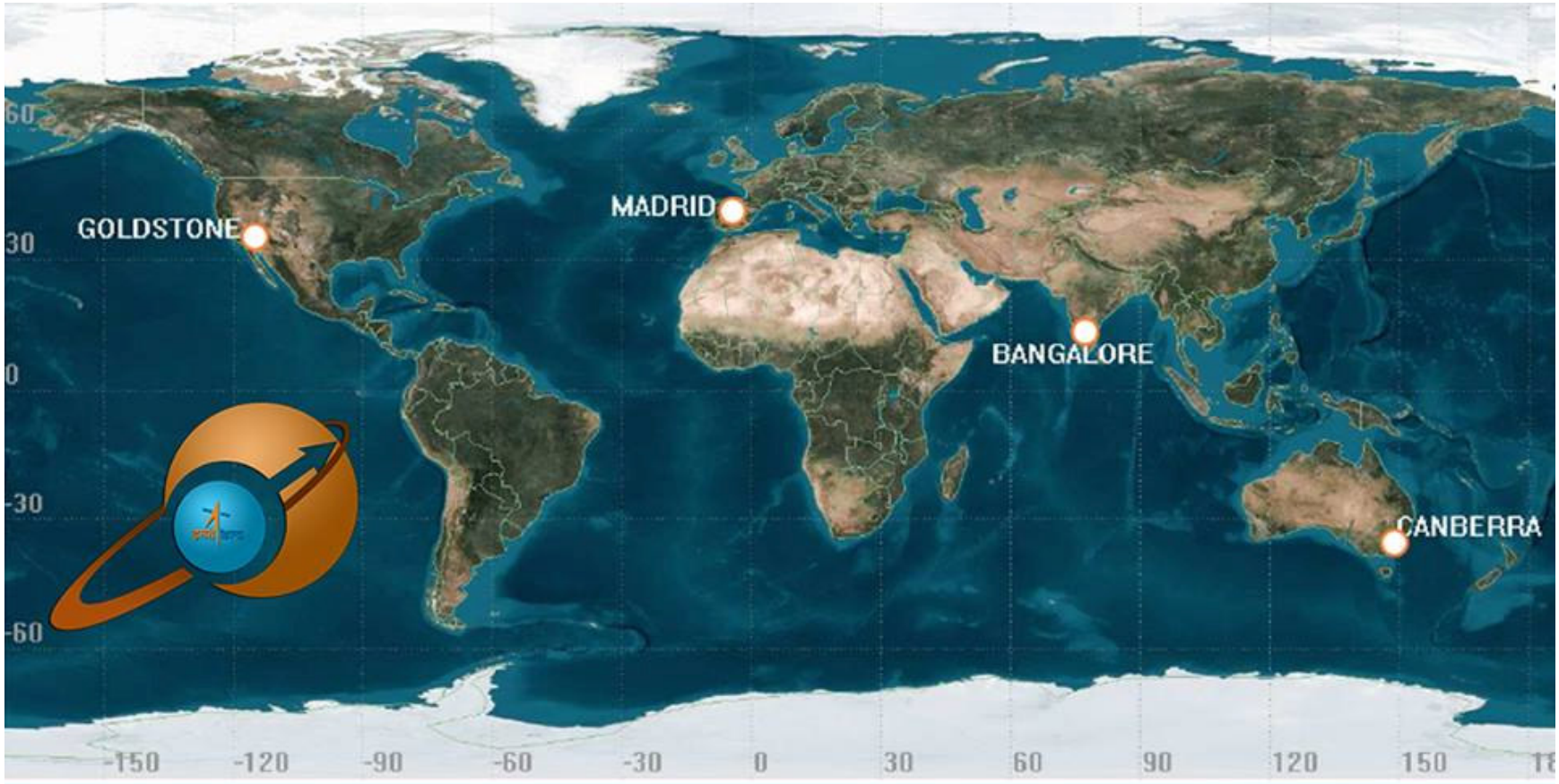
Re-orienting the Spacecraft
MOM is reoriented to align the thrust vector- before firing the engines to reduce the velocity.

In the Shadow of Mars
Because of the Mars-Sun-Earth geometry, the orbit insertion is destined to happen while MOM is in eclipse. MOM enters eclipse 5 minutes before Burn Start.

Engine Firing
The Main liquid Engine and eight smaller thrusters fire, imparting braking velocity of 1098.7 m/s.

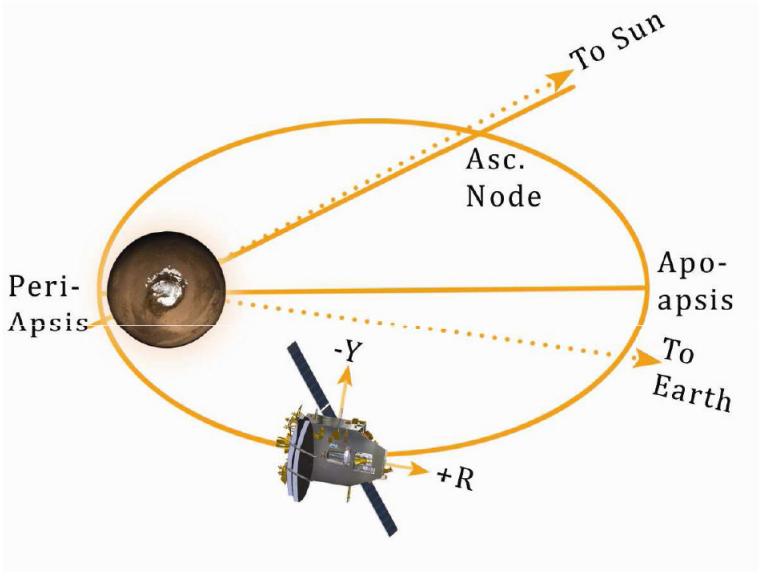
The communication blackout
The radio link between MOM and Ground station gets blocked by Mars and MOM executes all operations autonomously.

Resuming Communication
The burn is terminated when the required braking velocity is achieved and MOM is in Martian Orbit. The spacecraft is reoriented to point its Antenna towards Earth to resume communication.



Ground Station Support for Mars Orbit Insertion

Nominal orbit around Mars

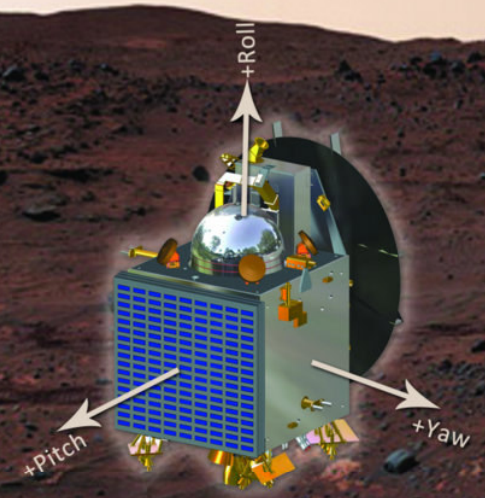


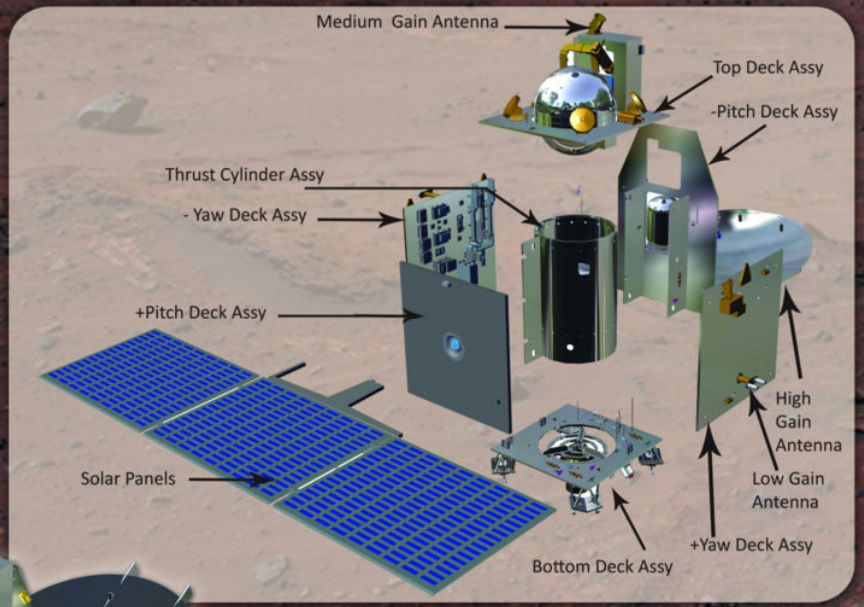
Estimated arrival altitude as of now	723 km
Estimated arrival altitude post TCM4/Test firing	515 km

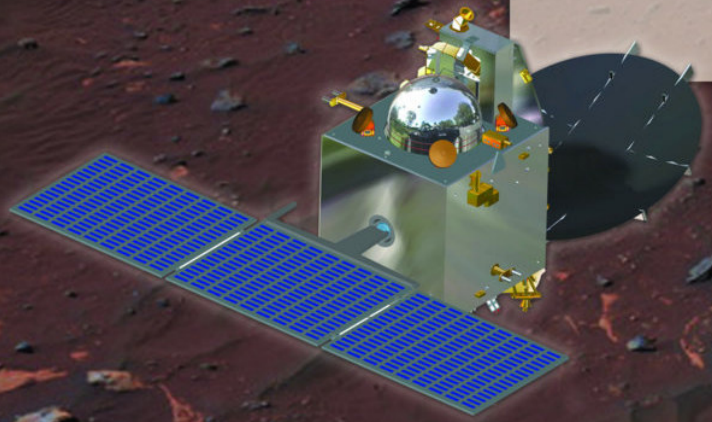
Mars Orbit Insertion
with Main Liquid Engine + 8 AOCE thrusters

Burn duration	1454 seconds (24 minutes & 14 seconds)
Propellant consumption	249.5 kg
ΔV imparted	1098.7 m/s
Nominal Orbit around Mars	423 X 80,000 Km
Orbital period	3.2 Earth days

Mars Orbiter Mission







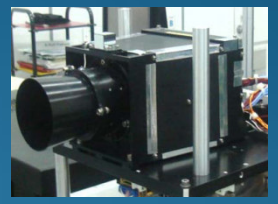
Payloads on MOM

MOM carries 5 Payloads

Total Weight 13 kg

SAC, Ahmedabad

- MARS Colour Camera (MCC)



- Methane Sensor for MARS (MSM)

- Thermal Infrared Imaging Spectrometer (TIS)

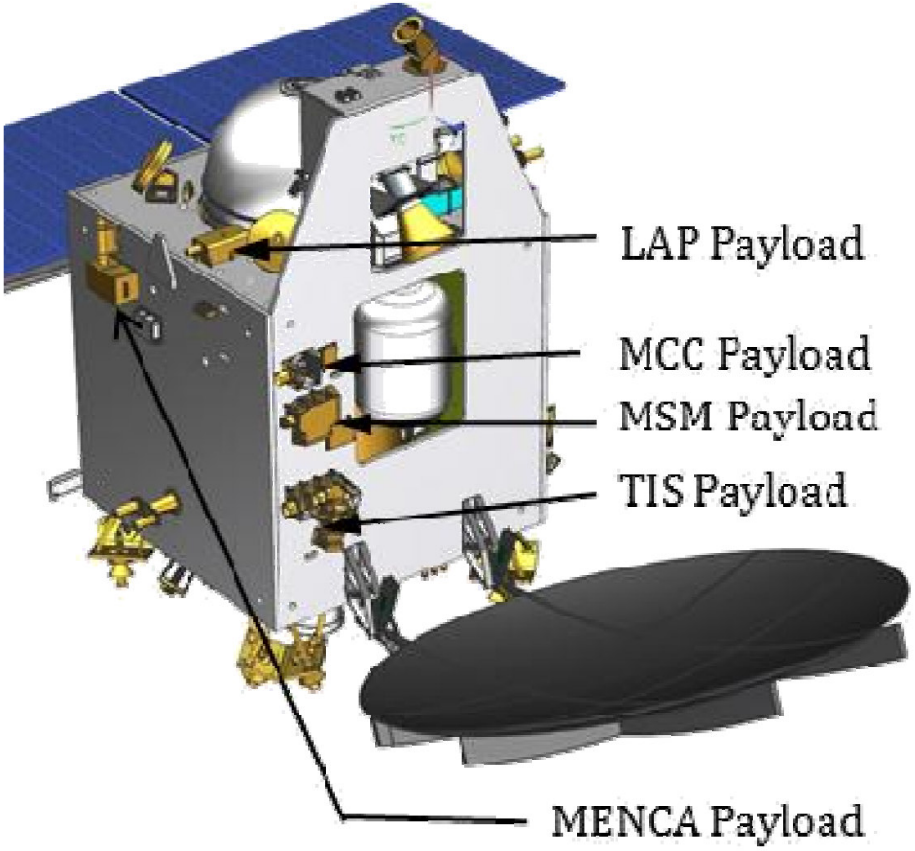
LEOS, Bangalore

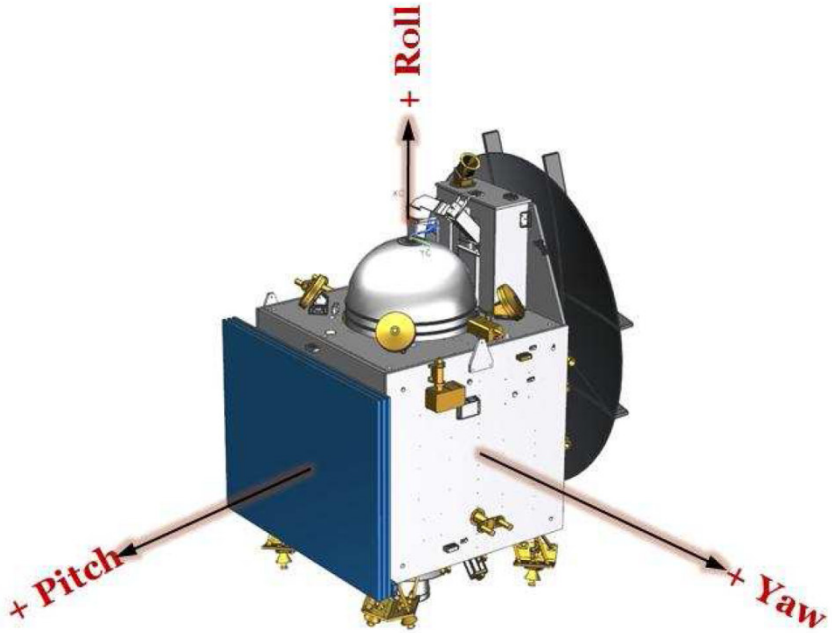
- Lyman Alpha Photometer (LAP)

SPL-VSSC, Trivandrum

- Mars Exospheric Neutral Composition Analyser (MENCA)

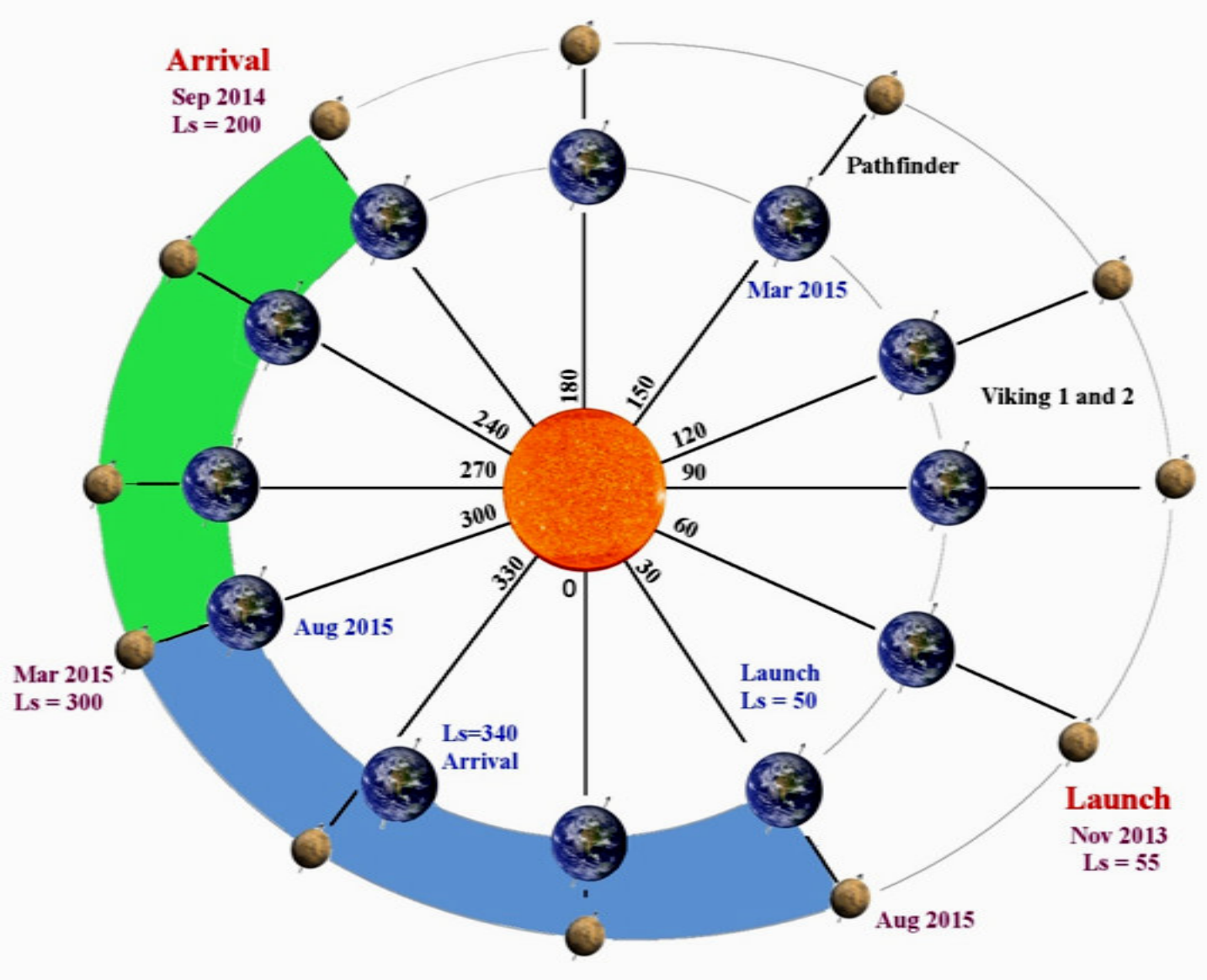
Accommodation of Payloads on the Mars Orbiter Mission





View from +Pitch/+Yaw axis

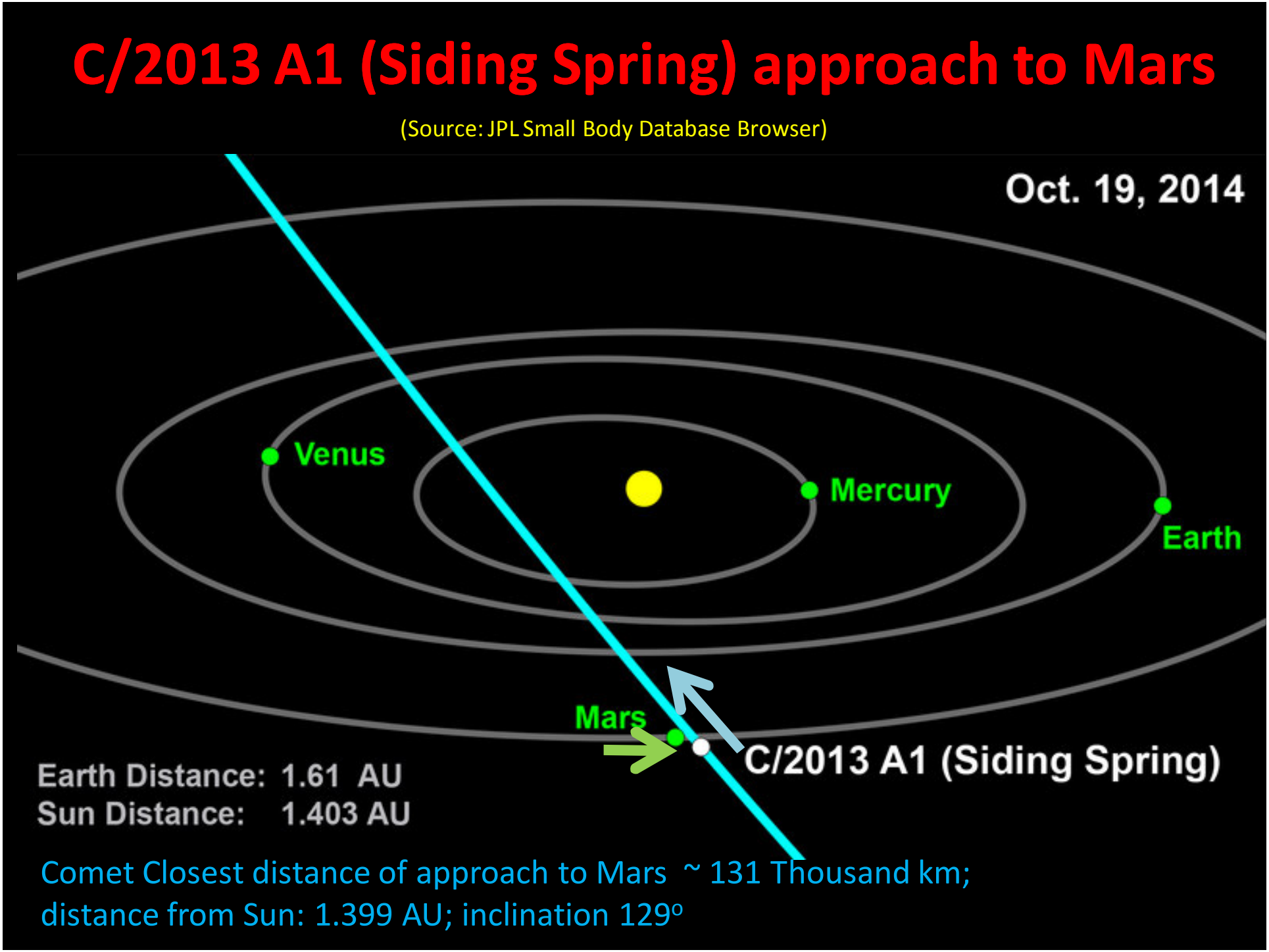
Mars Observation Phase



Position of Mars at the Launch and Arrival, and during the mission phases (six-months), and extended mission phase

C/2013 A1 (Siding Spring) approach to Mars

(Source: JPL Small Body Database Browser)



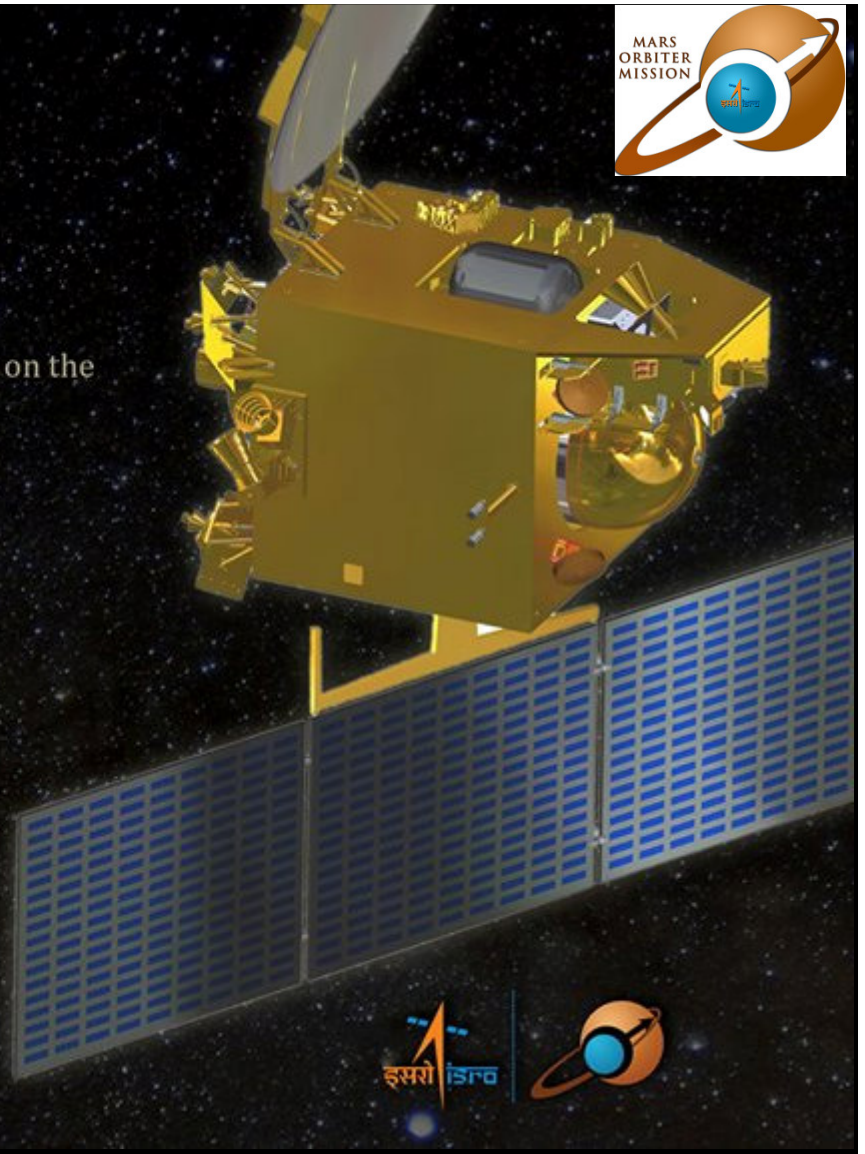
Comet Closest distance of approach to Mars ~ 131 Thousand km;
distance from Sun: 1.399 AU; inclination 129^{o}

The path of no return !

The die has been cast.
MOM has crossed the rubicon,
never to return to Earth.

MOM has broken free from the shackles of gravity and is on the one way road for a rendezvous with the red planet

facebook.com/isromom



Stay Tuned !!

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धन्यवाद
Thank You